PATENT SPECIFICATION 1,146,575

DRAWINGS ATTACHED.

1,146,575

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COMPLETE SPECIFICATION.

Improvements in Radial Flow Machines such as Pumps, Compressors or Turbines.

We, MANNESMANN-MEER AKTIENGESELLSCHAFT, of Karmannstrasse 29, Munchengladbach, Germany, a German Body Corporate, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to radial flow machines such as pumps, compressors or turbines having adjustable stator parts.

The essential aim of the invention is to provide an improved adaptation of such machines to varying operating conditions with respect to flow through the machine and pressure; the term "pressure" is applied herein to the total manometric head in the case of compressors, and to the hydrostatic head in the case of pumps and turbines.

It is known that the flow sections in the spiral or volute casing, or in the annular diffuser or converger chamber, or in both, may be controlled, and in the latter case by the displacement of a partition common to both so that the adjustment of the partition on the flow sections in the spiral casing and in the diffuser or converger takes place in a fixed ratio to one another. It is also known that a baffle or the like adjoining the rotor, may also be displaced at the same time. The adaptation attainable with the above devices is inadequate, however, since they primarily effect only one function, that is to say the flow through the radial flow machine or manometric head or hydrostatic head.

It is also unavoidable that each adjustment effecting a definite flow section causes a lesser secondary reaction on another flow section. This secondary reaction is mandatorily established by the form of construction of the radial flow machine, and its action varies in magnitude within the range of adjustment of the primary flow section. As a result, these secondary reactions cause performance control curves of characteristic curvature.

The invention consists in a radial flow machine such as a pump, compressor or turbine having an annular diffuser or converger section and a spiral or volute section, each of the sections having a side wall movable in a direction parallel to the axis of the shaft of the radial flow machine to adjust the flow of fluid through the section, and each of the or volute casing can be adjusted independently of the other.

The essential feature of the present invention is that the flow sections in either the annular diffuser or converger or the spiral or volute casing can be adjusted independently of the other.

As a result of this feature, it is possible to exercise linear control over one section whilst keeping the other constant, so that the primary adjustment of the second section required to balance the secondary reaction may be performed in a non-linear manner. The independent adjustment of the flow sections in the annular diffuser or converger and in the spiral or volute casing moreover results in a considerable reduction of the unstable working range and in very high and flat efficiency curves in the case of pumps and compressors.

In certain cases however, the optimum adjustment need nerely be applied to the flow sections in respect of flow through the radial flow machine and manometric or hydrostatic head, to obtain the efficiency required. In accordance with the invention, this may be accomplished by a proportional adjustment of the flow sections in the spiral or volute casing and in the annular diffuser or con-

verger. With a reduction of nominal flow through the machine, this results in a very flat pressure curve, rising slightly at zero flow through the machine.

In view of the fact that one may or may not desire the displacements of the adjustable side walls in the annular diffuser or converger and in the spiral or volute casing to be proportional to each other, the adjustable side wall of the annular diffuser or converger is arranged independently of the adjustable side wall in the spiral or volute casing and guided between a rubbing seal arranged on the adjustable side wall in the spiral casing and a fixed grade ring which is situated in the central area of the annular diffuser or converger.

Pressures act on the adjustable side wall in the annular diffuser or converger, since the kinetic energy is converted into pressure or vice versa, in the annular diffuser or converger passage. The rubbing seal is arranged on the adjustable side wall so that the pressure exerted on a first face of the movable side wall in the annular diffuser or converger section adjacent the flow of fluid is substantially equal to the pressure exerted on the faces of the movable side wall opposite the first face so that a small force is needed to adjust the movable side wall in the annular diffuser or converger section.

The following description and the accompanying drawings are given by way of example wherein:

Figure 1 is a schematic section taken through the radial flow machine according to the invention, comprising an annular diffuser or converger with parallel sides, and

Figure 2 is an analogous section taken through the radial flow machine according to the invention, comprising an annular diffuser or converger having a tapered section.

As apparent from Figure 1, the pressure casing comprises the fixed sides 1 and 2 and the outer, axially extending spiral side 3. The cover 4 of the rotor 5 is fastened to the side 2.

The adjustable side walls 6 and 8 of the annular diffuser or converger 7 and of the spiral casing 9 respectively are arranged to be axially displaceable relative to the fixed side 2, within the pressure casing 1, 2 and 3. The pressure casing side 2 has arranged on it a displacing device 10 for the side 8 of the spiral casing 9, and a displacing device (not shown) for the adjustable side wall 6 of the annular diffuser or converger, which latter displacing device is arranged on a centre line 11 radially offset from the centre line of the displacing device 10. Any appropriate displacing devices may be employed for this purpose. It is advisable to incorporate a device indicating the stroke of the displacing device, for example, a pin 12 displaceable in the axial direction for indicating the momentary position of the adjustable side wall 8 for providing a datum for control purposes.

The adjustable side wall 6 of the annular diffuser or converger 7 has a rubbing seal 13 disposed thereon and is adapted to slide between a fixedly mounted guide ring 14 located adjacent the rubbing seal 13 in the pressure casing, and a rubbing seal 15 arranged on the adjustable side wall 8 of the spiral casing 9. The rotor 5 impels fluid into the pressure casing 1, 2 and 3. The fluid is divided into streams including one stream which flows through the annular diffuser or converger 7 causing forces Po and Pu to be exerted against a first face of the adjustable side wall 6 and into the spiral casing 9. Some of the fluid then flows between the side wall 8 and the casing portions 3 and 2 into a chamber 16 where it exerts a force P_{16} on another face of the adjustable side wall disposed in the chamber 16 opposite the said first face. Another stream flows directly into a chamber 17 and causes a force P_{17} to be exerted against a further face of the adjustable side wall 6 opposite the said first face. The guide ring 14 is situated at a distance from the centre line of the machine such that the sum of the differential thrust forces $P_o—P_{16}$ and $P_u—P_{17}$ which act on the said first face of the adjustable side wall 6 adjacent the flow of fluid through the diffuser or converger and the faces of the adjustable side 6 opposite the said first face is approximately equal to zero. Accordingly, the power required for the displacements is very small, thus commensurately reducing the cost of any automatic control system applied.

The modified form of construction according to Figure 2 differs from that of Figure 1 in that the annular diffuser or converger 7 is of tapered cross-section in a plane containing the longitudinal axis of the shaft of the radial flow machine.

WHAT WE CLAIM IS:—

1. A radial flow machine such as a pump, turbine or compressor having an annular diffuser or converger section and a spiral or volute section, each of the sections having a side wall movable in a direction parallel to the axis of the shaft of the radial flow machine to adjust the flow of fluid through the section, and each of the side walls being movable independently of the other side wall.

2. A radial flow machine as claimed in claim 1 wherein the side wall in the annular diffuser or converger section has a rubbing seal disposed thereon and is guided between a fixed guide ring located in the central area of the annular diffuser or converger

section, and a seal disposed on the movable side wall in the spiral or volute section.

3. A radial flow machine as claimed in claim 1 or 2, wherein the annular diffuser or converger is of rectangular cross-section in a plane containing the longitudinal axis of the shaft of the radial flow machine.

4. A radial flow machine as claimed in claim 1 or 2 wherein the annular diffuser or converger is of a tapered cross-section in a plane containing the longitudinal axis of the radial flow machine.

5. A radial flow machine as claimed in any one of the preceding claims wherein the pressure exerted on a first face of the movable side wall in the annular diffuser or converger section adjacent the flow of fluid is substantially equal to the pressure exerted on the faces of the movable side wall opposite the first face so that a small force is needed to adjust the movable side wall in the annular diffuser or converger section.

6. A radial flow machine such as a pump, turbine or compressor substantially as hereinabove described with reference to the accompanying drawings.

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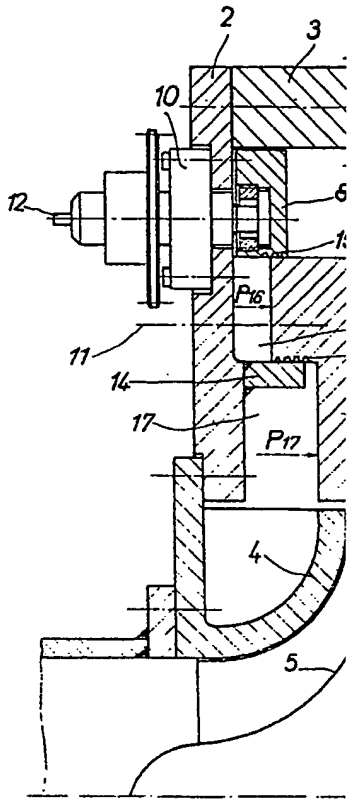
Fig. 1



1146575 COMPLETE SPECIFICATION
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 1 & 2

Fig. 2

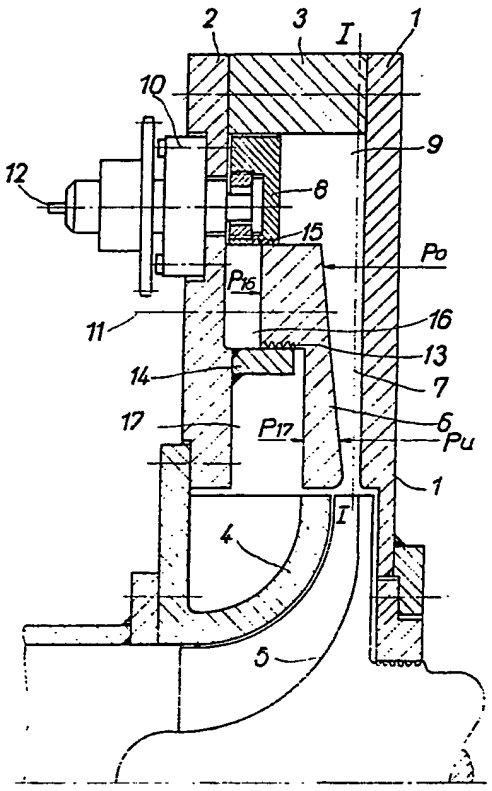


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Fig. 1

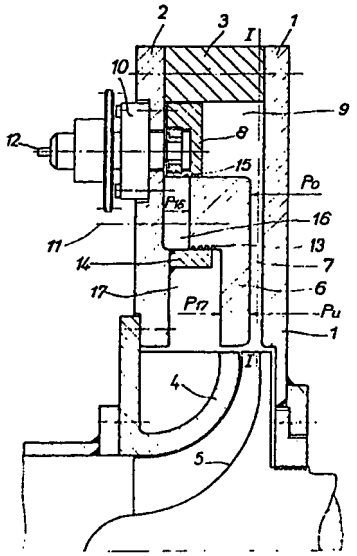

Fig. 2